

# Litman, Yehonathan

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## Research & Experience

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### Human Sensing Laboratory - Robotics Institute

*CMU - Pittsburgh, Pennsylvania*

GRADUATE RESEARCH ASSISTANT

*Aug. 2022 - Present*

- Currently working on physics based rendering and capturing information of objects about materials, lighting, and geometry.

### Robot Perception Lab - Robotics Institute

*CMU - Pittsburgh, Pennsylvania*

GRADUATE RESEARCH ASSISTANT

*Sep. 2020 - Aug. 2022*

- Part of the US military Aided Threat Recognition from Mobile Cooperative and Autonomous Sensors (ATR-MCAS) program.
- Deployed a simple RANSAC approach in visual inertial odometry with multiple stereo cameras and a single IMU for UGV navigation.
- Developed a large scale mapping solution for UGVs using an efficient 3D occupancy scrolling grid framework.
- Developed a custom graph optimization scheme that combined image registration and local VIO measurements in order to produce drift-corrected global localization measurements at a high rate using little computational resources.
- In conjunction with a scan matching image registration technique, showed superior results to state-of-the-art algorithms, as the system was able to conduct global localization both in real time and at a much higher accuracy.

### AirLab - Robotics Institute

*CMU - Pittsburgh, Pennsylvania*

GRADUATE RESEARCH ASSISTANT

*Jul. 2021 - May 2022*

- Implemented code for acquiring and building a training/testing dataset of panorama images from Google Street View and Google Earth Studio.
- Constructed a self-supervised encoder-decoder model that extracted illumination and lighting orientation features from panorama image batches, to condition relighting across a time distribution.

### DARPA Subterranean Challenge - Team PLUTO

*UPenn - Philadelphia, Pennsylvania*

RESEARCH ASSISTANT

*Aug. 2019 - Dec. 2019*

- Inspired by direct visual SLAM, devised a bundle adjustment approach on both thermal and RGB images using direct image alignment, providing a robot with a metric dense environmental representation with multi-spectral information to significantly aid object detection.
- Made a direct matching methodology that utilizes only a single standard camera in order to thoroughly fuse and stitch together multiple thermal images while compensating for weaknesses in thermal readings.

### GRASP Laboratory - SUNFEST REU

*UPenn - Philadelphia, Pennsylvania*

RESEARCH ASSISTANT

*May 2019 - Aug. 2020*

- Drove a custom swarm assembly algorithm that could make extensive modular quadrotor formations using only vision and onboard sensors.
- By fusing visual, inertial, and magnetic measurements, derived a novel controller algorithm for detecting a docking between two quadcopters that is also resistant against external forces encountered outdoors.
- Made a testing framework in Gazebo using ROS and PX4-SITL for simulating a swarm of modular quadrotor robots. By simulating magnetic forces, the testing framework proved to be a realistic simulation that can be applied onto real quadcopters with no modifications to the software.

### Nanomaterial Energy Harvesting and Sensing Laboratory

*SUNY SBU - Stony Brook, New York*

UNDERGRADUATE RESEARCH ASSISTANT

*Sep. 2016 - May 2020*

- Improved the theory behind incremental based SLAM in order to dramatically accelerate tracking using a machine-learning inspired data fragmentation process, exhibiting vastly superior position tracking performance when compared to other leading visual-inertial methodologies.
- Developed, Using the aforementioned algorithm, an extremely light yet highly accurate visual inertial odometry tracking algorithm for ultra-low power ARM-based processors such as a Raspberry Pi.
- Devised an invariant Extended Kalman Filter algorithm for a more robust visual inertial odometry strategy that considered yaw, leading to competitive performance against other leading visual inertial based odometry techniques.
- Due to the unavailability of a motion capture system for experimental validation, built a quadcopter platform equipped with an NVIDIA Jetson processor capable of generating groundtruth stereo depth data via convolutional neural network training.
- Formulated a novel optical flow based background reduction algorithm for human detection in cluttered environments for 99% accurate detection of stationary humans and 90% accurate detection of moving humans.

### URECA Summer Research Program

*SUNY SBU - Stony Brook, New York*

PRIMARY INVESTIGATOR

*May 2017 - Sep. 2017*

- Designed an interlinked multi-redundancy SLAM system for reliable position sensing in both outdoor and indoor settings by fusing the readings of a 3D sensing camera, LiDAR, IMU, GPS, and a barometer.
- Implemented a simplified attitude control algorithm for use in both basic and complex maneuvers.
- Constructed quadcopter capable of 3D SLAM both indoors and outdoors for several functions such as aerobatic displays, outdoor GPS assisted navigation, indoor navigation in constrained areas, and swarm formations.

## Education

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### Carnegie Mellon University

PH.D./M.S. IN ROBOTICS

- Cumulative GPA: 3.95/4.33

Pittsburgh, Pennsylvania

Aug. 2020 - Present

### State University of New York at Stony Brook

BACHELOR OF SCIENCE, COMPUTER SCIENCE MAJOR, ELECTRICAL ENGINEERING MINOR

- Cumulative/Computer Science GPA: 3.5/4, **Cum Laude**
- University Scholars Honors Program

Stony Brook, New York

Aug. 2016 - May 2020

## Awards

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- 2022 **NSF Graduate Research Fellowship Program (GRFP)**
- 2020 **Provost's Award for Academic Excellence**, Given to 6/1000+ graduates
- 2019 **IROS Student and Developing Countries Travel Award**, Merit-based
- 2019 **NSF & Lehigh I-DISC Travel Award**, Merit-based
- 2017 **URECA Fellowship Grant**, \$4,000

## Service

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### ICRA 2023, IROS 2022

REVIEWER

### ROB 16682 - Robotics Systems Development Project II

TEACHING ASSISTANT

CMU - Pittsburgh, Pennsylvania

Fall 2020

## Skills

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- Programming** C/C++, Python, Java, JavaScript, LaTeX, Bash
- Frameworks** OpenCV, PyTorch, ROS, GTSAM, Pixhawk, Neon SIMD, Arduino
- General** Linux, Git, Vim, Adobe Photoshop, Blender, Autodesk Inventor, Vicon
- Languages** Hebrew, English, German (A2)

## Publications

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### JOURNAL PROCEEDINGS

- [1] **Yehonathan Litman**, Neeraj Gandhi, Linh Thi Xuan Phan, and David Saldaña. "Vision-Based Self-Assembly for Modular Multirotor Structures". In: *IEEE Robotics Automation Letters (RA-L) with presentation at 2021 IEEE International Conference on Robotics and Automation, (ICRA)*. 2021, **Finalist Paper in Multi-Robot Systems**.

### CONFERENCE PROCEEDINGS

- [1] **Yehonathan Litman\***, Daniel McGann\*, Eric Dexheimer, and Michael Kaess. "Global Visual-Inertial Ground Vehicle State Estimation via Image Registration". In: *2022 IEEE International Conference on Robotics and Automation, (ICRA)*. Philadelphia, USA, May 2022.
- [2] **Yehonathan Litman**, Ya Wang, and Ji Liu. "Accelerated Visual Inertial Navigation via Fragmented Structure Updates". In: *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Macau, China, Nov. 2019.
- [3] **Yehonathan Litman**, Libo Wu, and Ya Wang. "Invariant Filter Based Preintegration for Addressing the Visual Observability Problem". In: *2018 IEEE MIT Undergraduate Research Technology Conference (MIT-URTC)*. Cambridge, Massachusetts, Oct. 2018.
- [4] Libo Wu, Haili Liu, **Yehonathan Litman**, and Ya Wang. "Shuttered Passive Infrared Sensor for Occupancy Detection: Exploring a Low Power Electro-Mechanical Driving Approach". In: *2018 Conference on Smart Materials, Adaptive Structures and Intelligent Systems (ASME)*. Tech. Rep. San Antonio, Texas, Sept. 2018. URL: <https://yehonathanlitman.github.io/papers/SMASIS2018.pdf>.

## Presentations

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- [1] **Yehonathan Litman**, David Saldaña, and Vijay Kumar. “Vision-based Docking and Assembly for Modular Quadrotor Structures”. In: *2019 National Science Foundation (NSF) Robot Learning Workshop*. Bethlehem, Pennsylvania, Oct. 2019, Poster Presentation.
- [2] **Yehonathan Litman**, Haili Liu, and Ya Wang. “A Simple Interlinked Controller-Sensor Framework for Robust SLAM and Autonomy on MAVs”. In: *2018 Undergraduate Research & Creative Activities (URECA) Annual Research Symposium*. Stony Brook, New York, Apr. 2018, Poster Presentation.